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Relating Biochemical, Physiological, and Psychological Disorders to the Social Environment

Lawrence E. Hinkle, Jr., New York

AT a scientific meeting, when there is a consideration of the environment, it is customary to hear it discussed under two headings: "physical" and "social." There have been historical reasons for this. Over the past four centuries, physics, chemistry, and biology have been woven together gradually into a connected body of knowledge that appears to describe a "physical" world. True, it was not until quite recently that it became possible to describe many fundamental biological processes in terms that are compatible with our current understanding of physics, chemistry, and mathematics. Many of the more complex biological phenomena still cannot be described in these terms. Yet it is fair to say that no major intellectual gaps now separate biology from the other natural sciences. In the past this could not be said of sociology and psychology. The concepts of these sciences were not closely connected with those of the natural sciences. To many they seemed to describe another world that has often been called the "social environment."

The intellectual discontinuity which separated the social and behavioral sciences from the common body of concepts that now

unite the physical and biological sciences arose, in part, from two historically different ways of looking at man and his environment. Social and behavioral scientists have not always found in the "hard sciences" concepts that could help them understand many of the phenomena that they must deal with. Until very recently "hard science" had no reasonable hypotheses to explain how "thinking," "memory," or "voluntary activity" might take place. The possible connections between "morality," "private property," and the centimeter-gram-second system seemed remote, to say the least. There was no good "scientific" way to explain how a man might develop more florid diabetes mellitus after he lost his job, or suffer an increased risk of coronary heart disease because his father had only a grammar school education. Faced with the necessity of dealing with such phenomena, social and behavioral scientists developed concepts of their own, sometimes derived from the introspective or the philosophically "idealist" points of view. I do not wish to imply that these are not valuable and important points of view. I wish only to point out that they are different from the point of view common to the natural sciences.

It will be the burden of this presentation that intellectual developments of the present century are gradually making it possible to understand many phenomena of human society and human behavior in terms familiar to the natural scientist. I shall reiterate a familiar thesis: that the time is already at

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hand when many scientists—biological, social, and behavioral—have taken a unitary view of the man-environment relationship, and have abandoned the needless dichotomy of a “physical” and a “social” environment.

Role of Order and Organization

Foremost among the intellectual developments that I have in mind have been the concepts leading to the recognition of the role of order and organization in the natural world—developments with which many of the great names in biology have been associated. The application of these concepts has gradually brought about the recognition that a unique property of living organisms lies in the fact that they are hierarchies of highly ordered, extremely “improbable” organizations of rather common elements, which maintain their order over a finite period of time by the consumption of free energy. Today we have a view of the manner in which atoms are organized into the molecules of living organisms, the molecules into subcellular organelles, the organelles into cells, the cells into tissues and organs, and the organs into whole organisms. We have a general idea of many of the complex energy transfers and feed-back mechanisms that enable the organism to maintain its integrity in the face of a constantly changing environment. We see how the nervous system of the organism acts as a central integrator, how it greatly enhances the ability of the organism to react to present situations on the basis of past experience, and how, with its aid, the organism can react to events that are distant from it in time and space. During the past three decades “information theory,” which I might describe as a sophisticated theoretical treatment of problems of “order,” “choice,” and “improbability,” has had an impact on biology that is almost as great as its impact on computation and communication. It has provided a framework within which we have begun to understand the operations of the sense organs, the transmission of neural impulses, and some of the bases for such neural activities as memory and cognition—as well as providing us with the basis for understanding such diverse processes as how genetic inheritance may occur, or how cells manufacture proteins.

From the point of view of the naturalist an organism such as a man has only one “environment.” It envelops him, and he, in fact, envelops part of it, for the air in his lungs and the food in his gastrointestinal tract are still part of his environment until they are absorbed. The constant and intimate interaction of organism and environment is a fundamental feature of life. The view of the living organism as a very complex biological organization maintaining itself in a dynamic equilibrium with its environment is, in a certain sense, an extension of the concept of homeostasis which Cannon, in the 1920's, applied to the fluid environment surrounding the cells; but it is different from homeostasis in one important respect: the “homeostatic” mechanisms that maintain the constancy of the extracellular fluid are more or less nonspecific and quantitative in their response, while the response of the organism to its external environment is largely of a communicative nature. It is based on the recognition and evaluation of patterns of energy. It is therefore highly specific, and in almost no way related to the quantity of energy that is received. Indeed, if this were not true, the survival of an organism would be impossible. If a man reacted in the same way to a poliomyelitis virus, to a glucose molecule, or to a shout of “Fire!” he would not last very long. Even these are oversimplified examples. The human organism differentiates between the subcategories of poliomyelitis viruses and reacts to each of them differently depending upon its past experience with it. The organism has a different mechanism for handling d-glucose and l-glucose. And, as each of us knows, a man's reaction to the shout of “Fire!” is very different if he hears the word shouted by an actor on television, by the commander of a gun crew, or by a panic-stricken person in a crowded room.

Events and situations encountered by the organism do not create a nonspecific stress in it, but evoke from it highly complex and quite specific patterns of reaction. The only nonspecific feature of these reactions is the repeated participation of the same muscles, glands, cells, and enzyme systems in the response to a great many different challenges. Since it has only a limited number of component parts, each of which has only a

limited repertoire of reactions, the organism must, perforce, use the same notes and the same refrains in a great many different biological symphonies.

The reaction of the organism to its environment is never homeostatic for the entire organism. In fact, it is likely to be destructive for part of the organism. An organism usually acts in a manner such that it maintains its higher order functions even at the expense of its lower order functions. Although I am not sure that it is often explicitly stated in the biological literature, it is nevertheless widely recognized by biologists that, in the hierarchy of organizations that make up the organism, the less complex levels of organizations are subordinated to the more complex. Thus, the fats, proteins, carbohydrates, and minerals that make up the subcellular structure, are constantly active in metabolism, and many of them are destroyed and reconstituted again and again. Subcellular organelles appear and disappear as cells divide and change their metabolic state, while the cell as an organization survives. Yet cells themselves are created, mature, function and die constantly, while tissues and organs maintain their identity. A steady growth and destruction of cells is an outstanding feature of such organs as the bone marrow, the skin, the intestines, and the uterine endometrium. Only the central nervous system fails to renew itself constantly at the expense of its component cells—possibly because significant portions of its complex learned memory are intracellular. Yet, even the central nervous system reacts like other organs when its integrity is threatened by a foreign substance or by microbial invaders. Under these circumstances it sacrifices some portion of its own cellular substance to create an inflammatory wall that protects the rest.

Internal and External Environment Relationships

There are some relationships within the "internal environment" of the organ that seem to apply, at least by analogy, to the relation of the organism to its "external environment." One of these has relevance to the relation of men to their societies. Social organizations are biological organizations.

Families, cities, and nations are the biological organizations characteristic of the animal "man." A society is not an organization of men in the same sense that a man is an organization of cells and organs, but these two types of biological organization do have some similar features. One of these is the primacy of the requirements of the higher levels of organization. Just as the biological needs of individual cells and organs are sacrificed, if need be, to maintain the integrity of the organism, so the biological needs and even the lives of individual men are subordinated to the requirements of the societies of which they are members.

I am sure that many of us do not often contemplate the extent to which this is true. We accept that the society may, on rare occasions, ask us to give up our lives in military service, or prevent us from driving the wrong way down a one-way street; but we do not frequently reflect upon the degree to which the demands of our social organizations circumscribe our freedom to satisfy even our simplest biological needs. Take the matter of hunger, for example. A hungry man sitting on a park bench might, if he wished, seize the nearest pigeon, pluck it, and eat it raw. This would satisfy his biological needs with a nourishing mixture of fat and protein. Yet almost no man in our society would do this. He would go hungry indefinitely rather than do so. He would go hungry rather than eat anything that is not defined as "food," that is not prepared in an acceptable manner, and that is not served to him in a place considered proper for eating. During the Korean conflict some American prisoners of war literally starved themselves to death rather than eat the rice and gruel that their Korean captors provided for them, because they regarded these as "unfit to eat."

Social groups have never behaved as if the biological needs of their individual members took precedence over all other considerations. They behave, rather, as if the primary duty of the individual is to fulfill the various social roles in which he finds himself, and they make provision for ameliorating the demands of these roles only when they are grossly destructive to the individual. In our society, for example, a man may be expected to get up on a working day even though he

is tired and sleepy; to ride to work on a crowded bus reeking with exhaust fumes even though he is uncomfortable and nauseated; to arrive at work on time no matter what frustrations and impatience the traffic may cause him; to do a day's work without rebelling, however dull or monotonous it may be; to deal with his unpleasant boss without assaulting him; to cope with the crises and challenges of daily life without giving way to panic; to work alongside his pretty secretary without making advances to her; to make his way home to a tired and complaining wife without deserting her; to help his children with their homework without shouting at them; and then to spend the rest of the evening reading and working on reports for the office in order to get ahead in his job and gain a promotion. None of this is homeostatic for him in the simplest sense. He behaves as the social group dictates because he has learned from his earliest childhood that this is the appropriate way to behave. Furthermore, there are rewards for behaving as the social group prescribes, and punishments for not doing so. Unless a vast number of instructions for appropriate behavior had been ingrained within each of us by our experiences from earliest childhood—"learned" or "programmed," if you wish—our complex society could not exist.

Men are the animals that are characterized by the creation of the most elaborate and highly sophisticated cultures, and by the development of the most complex societies. A very large part of the physical environment in which men live is made up of the artifacts of their own culture. They so control and manipulate the gross physical features of their environment that before very long the traditional threats to human health and survival—microbial parasites, failure of the food supply, accidental trauma and direct aggression—will probably have been replaced entirely by threats of man's own making: chemical substances that he ingests and inhales, an overabundance of food, the constant state of arousal created by the time demands and contingent challenges of the societies he lives in, the sophisticated methods of communication and transportation that he has developed, and the secondary effects of the suppression of direct aggression that is so necessary to life in

a civilized society. In the future we can expect that no small part of human illness will be determined by the interaction of men with other men, and by their adaptations to the social roles that are thrust upon them.

The culturally determined behavior of men, their adaptations to their social groups, and their interactions with the people around them may have a most profound effect upon their health. Three decades ago it was commonly believed by physicians that a man's experiences with his society might upset him emotionally, and perhaps disturb a few of his vegetative functions for a day or so, but that they rarely had any permanent effect upon his "organic" health. Today the view of many medical practitioners has not changed a great deal, but that of human biologists has changed vastly. It has become evident over the years that the central nervous system exerts a high degree of control over all of the endocrine glands. Through them, and through its neural connections, it influences almost every metabolic process of the human organism. By a combination of the effects of endocrine and neural influences, and by the effects of the gross behavior of the person, any disease, whether it be infectious, parasitic, traumatic, metabolic, degenerative, or neoplastic, may be influenced, to some extent, by the interactions of man with his society and with other men. There is no longer any good reason to believe that there is a special and limited category of diseases which should be called "psychosomatic." Either all disease is "psychosomatic," or none is, depending upon how one wishes to look at it.

The effects of men's adaptations to their social roles are apt to have consequences that are long-term as well as short-term, and these consequences are as likely to be subtle as to be dramatic. Furthermore, these consequences are as likely to arise out of the apparently beneficial and desirable aspects of the society as they are to arise out of aspects which are apparently harmful and undesirable.

Our present experience with coronary heart disease may be used to illustrate some of the points that I have just made. This disease is perhaps the most common cause of death in America at the present time, and it is certainly the most frequent cause of death

among American men in the prime of life; yet its widespread prevalence seems to be an outgrowth of several features of our society that we regard as most desirable.

Some reasons for this may be the following:

1. We have a high standard of living and an abundant diet high in animal fat and protein, and we are justly pleased with this; but we have also inherited the appetite mechanism of our hungry ancestors, and over a period of decades the combination of appetite and abundance has produced a high level of obesity throughout our population, and a high level of circulating fats and cholesterol in our blood. This, in turn, has led to the accumulation of cholesterol and other lipids in the arteries which supply blood to the muscles of our hearts.

2. We have a highly developed technology, which has largely replaced the labor of men with the labor of machines. Today few people in American society do much heavy physical labor over a long period of time—even construction workers and agricultural laborers now drive machines. As a result of this the muscles of many Americans—including the muscles of their hearts—have become relatively hypotrophic as compared to the muscles of people who labor actively. This has its disadvantages: when a coronary occlusion occurs in the relatively hypotrophic heart of an inactive man, it is more likely to cause death.

3. We are justly pleased that we have largely conquered the major infectious diseases of infancy and childhood, and that the life expectancy of an American at birth is now approximately 70 years; but as a result of this, a large proportion of our population is living long enough to experience the cumulative effects of an abundant diet and lack of exercise—and these effects progress slowly and insidiously without symptoms over a period of many decades.

4. If we are not pleased, we are at least awed, that we have developed an ever more elaborate society, with remarkably sophisticated means of transportation and communication, and with greatly increased opportunities for men to be socially mobile and to improve their lot in life. However, these developments have greatly increased the requirement that people meet time deadlines,

that they cope with challenges that cannot be met by direct action, that they devote themselves to long hours of purposeful activity, and that they separate themselves from the social milieu in which they originated. This, in turn, appears to have produced a sustained high level of “alertness” or “arousal” in a great many members of our society. There is some reason to believe that this, in itself, tends to raise the level of circulating fats and cholesterol, and that it is associated with frequent or sustained neural stimulation of the heart, with relatively increased heart rates over long periods of time, and with an increased susceptibility to the disturbances of cardiac rhythm which are so often fatal to people whose coronary circulation is impaired by atherosclerosis.

5. In addition to all this, during the last 50 years a great number of Americans have adopted the habit of smoking cigarettes, probably because it helps them to deal with the tensions and anxieties that so many of them experience; but cigarette smoking appears to have an adverse effect upon the blood vessels, and it, too, enhances the likelihood of a coronary occlusion.

Thus, many otherwise beneficial and desirable features of our society have combined with the effects of the ordinary behavior necessary to life in our society, with the physiological effects of our adaptations to our social roles, and with the effects of a habit that was long thought to be harmless, and together these have insidiously produced conditions under which coronary heart disease, an entity that was rare 200 years ago, has now become one of the most highly prevalent and lethal diseases of our times.

Summary

There is only one man-environment system. Although this system may be looked at from several points of view, the time has already arrived when the body of concepts that have become common to the physical and biological sciences are being extended to the social and behavioral sciences, and we are escaping from the dichotomy of a “physical environment” and a “social environment.” The man-environment relationship has always been a major determinant of hu-

man health. For modern man the elaborate culture that he has created and the extremely complex society in which he lives have already become outstanding aspects of the environment to which he must adapt. Even now we can look forward to a time when the traditional environmental threats to human health and survival will have been largely replaced by threats of man's own making. Often these will operate insidiously, over decades or generations. No small number of them may arise from the physiological effects of adapting to the demands of various social roles that men will have to assume. We can expect that sometimes these

threats may arise from aspects of our society, or from features of our social roles, that seem beneficial, and are highly valued and desired.

If all of this is true, it would seem that in the future, if medicine intends to promote longevity and freedom from disability, it will have to expend an ever greater proportion of its time and effort in attempting to understand the man-environment relationships that determine the occurrence of disease. It will no longer be able to limit its interests primarily to efforts to repair the effects of disease, or to reverse the course of disease after it has already appeared.

ADAPTATIONS IN MEDICINE

In the changing world of the 20th century, the practice of medicine has undergone radical adaptations. Rugged individualism prevailed until the scientific and technical advances in medicine made specialization inevitable and interdependence imperative. In the interest of the patient, group and associated practice have evolved on a comprehensive scale in this period. Among other factors, the requirement of diagnostic and therapeutic procedures has evolved complicated techniques and apparatus beyond the means of the individual practitioner. Hence the hospital has become the logical center of professional activity. With hospitalization insurance, and now medicare, this trend is inescapable. The physician owes it to himself and the community to contain this tide of institutional care within justifiable bounds. By careful judgment, an appreciable proportion of the eligible patients can and should be cared for in the office and home. The bridges between medicine and society are increasing in number and utilization. Medicine has come to the realization that health is not the exclusive prerogative of our profession. As a member of the modern health team, the physician will maintain leadership. From this vantage point, he will encourage the intelligent participation of and give guidance to the host of fellow-workers, professional and voluntary, in the health arts and sciences.

In a materialistic world, it is vital to the future of medicine as a professional and a social unit that we do not burn important bridges behind us. With the burgeoning weight of scientific advance comes an interesting and commendable deference to objectivity in procedure and deduction. However, the intrusion of impersonality threatens a traditional bulwark of medical strength. Not only is the mutual understanding in the patient-physician relationship of inestimable value to the latter in his analysis of the clinical status; but such reciprocal respect plays an appreciable part in that intangible but potent element termed co-operative therapy. No thoughtful physician would impede or deny the advances of automation and kindred esoteric skills in medicine. By the same token, John Brown's characterization has a currency that must not be overlooked in the whirlwind of progress that is apt to divert our attention to less fundamental principles, "that gentleness and compassion for his suffering fellow-men, without which no man—be his intellect ever so transcendent, his learning ever so vast, his industry ever so accurate and inappeasable—need hope to be a great physician, much less a virtuous and honest man."—Middleton, W.S.: *Medical Bridges, The Pharos of Alpha Omega Alpha* 29:116-121 (Oct) 1966.